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METHOD FOR CONTINUOUS WELDING AND CUTTING OF A PLASTIC SHEET
[PURASUTIKKUSHI-TO RENZOKU YOUCHAKU-SETSUDAN NO HOUHOU]

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SPECIFICATION

1. Title of the Invention

Method for continuous welding and cutting of a plastic sheet

2. Scope of the Claims

1. A method for continuous welding and cutting of a plastic sheet that is characterized by being a method for continuous welding and cutting of a plastic sheet wherein a cylindrical receiving jig that has a rotating shaft and an ultrasonic wave horn that is established opposing and adjacent to the said receiving jig outer periphery surface welding a plastic laminated unit in a continuous line or belt by ultrasonic vibrations of the aforementioned ultrasonic wave horn and cutting parallel to that welded section being performed with the establishment of a route perpendicular receiving jig perpendicular surface arranged along the outer periphery surface of a receiving jig for a rotating shaft of a receiving jig at least for the aforementioned receiving jig, and, also, the establishment of a perpendicular surface opposing section that has a parallel surface that is connected as opposing the outer periphery surface opposing section, which has a surface that is adjacent as opposing the aforementioned receiving jig outer periphery surface, and the aforementioned receiving jig perpendicular surface at the terminal section of an ultrasonic wave horn.

2. A method for continuous welding and cutting of a plastic sheet as claimed in the scope of Claim 1 that is characterized by an aperture of the outer periphery opposing section when the ultrasonic wave vibration ceases and a receiving jig outer periphery surface being ½ larger than the amplitude of an ultrasonic wave vibration that is applied,

and an aperture when the aforementioned receiving jig outer periphery surface and the aforementioned outer periphery opposing section are closest being smaller than the thickness of 1 plastic sheet that is welded during an applied ultrasonic wave vibration frequency.

3. Detailed Explanation of the Invention

[Field of Application]

The present invention pertains to a method for continuous welding and cutting of a plastic sheet wherein welding of a thermoplastic plastic sheet laminated unit is performed in a continuous line or belt along with cutting being performed in parallel with that welded section.

[Essentials of the Invention]

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The present invention is a method for continuous welding and cutting of a plastic sheet wherein a method for continuous welding and cutting of a plastic sheet has a cylindrical receiving jig that has a rotating shaft and an ultrasonic wave horn that is established opposing and adjacent to the said receiving jig outer periphery surface welding a plastic laminated unit in a continuous line or belt by ultrasonic vibrations of the aforementioned ultrasonic wave horn, and cutting parallel to that welded section being performed with the establishment of a route perpendicular receiving jig perpendicular surface arranged along the outer periphery surface of a receiving jig for a rotating shaft of a receiving jig at least for the aforementioned receiving jig, and, also, the establishment of a perpendicular surface opposing section that has a parallel surface that is connected as opposing the aforementioned outer periphery surface opposing section, which has a

surface that is adjacent as opposing the aforementioned receiving jig outer periphery surface, and the aforementioned receiving jig perpendicular surface at the terminal section of an ultrasonic wave horn, such as welding being performed by utilizing the aforementioned receiving jig outer periphery surface and the aforementioned outer periphery opposing section and cutting being performed by utilizing the aforementioned receiving jig perpendicular surface and the perpendicular surface opposing section, and the aperture of the aforementioned receiving jig outer periphery surface when ultrasonic wave vibration ceases and the aforementioned outer periphery surface opposing section is larger than ½ of the amplitude of the applied ultrasonic wave vibration, due to the establishment such as the aperture when closest being smaller than the thickness of 1 plastic sheet that is welded, the terminal section of the ultrasonic wave horn and the receiving jig have little abrasion, and the performance with stable welding strength and accurate cutting is possible.

[Prior Art]

Methods that use ultrasonic wave vibrations and methods that use high frequency electromagnetic waves are used as method for continuous welding and cutting of plastic sheets (below, called simply sheets) that perform continuous line or band welding of laminated units of thermoplastic plastic sheets along with parallel cutting of that welded section, but, recently, methods that use ultrasonic waves are more often used for the reason of good productivity.

Next, a prior art example of a method for continuous welding and cutting of a sheet that uses ultrasonic wave vibrations is explained by referencing Figure No. 7 through Figure No. 11.

Figure No. 7 is a structural diagram of an entire unit that represents a prior art example. After laminating 2 sheets 25a, 25b by a 1st guide roller 23, [the laminated unit] is conducted to an aperture of cylindrical receiving jig 22 that has a rotating shaft and ultrasonic wave horn (below, called simply horn) terminal section 21 that has an adjacent surface as opposing the said receiving jig outer periphery surface 22a, welding and cutting are continuously performed by that, the cut scraps 27 are removed and the laminated sheet 26 with the terminal section welded is recovered through a 2nd guide roller 24. Here, a model enlarged front view diagram of the area of the utilized horn terminal section 21 and the receiving jig outer periphery surface 22a is represented in Figure No. 8. Further, Figure No. 9 and Figure No. 10 are model enlarged side view diagrams; Figure No. 9 is a model representation of a sheet welding and cutting device (28 represents the welded section), and horn terminal section 21 is shown by a solid line for the position when ultrasonic wave vibration ceases, and both positions of horn terminal section 21 are shown by broken lines for when closest and when farthest during the vibration frequency during ultrasonic wave vibration (amplitude P) application. As shown in Figure No. 7 through Figure No. 9, the terminal has a round shape for horn terminal section 21, and cutting is produced by that most terminal section as shown in Figure No. 9, and the welding is produced at its surrounding section. When the aperture of a horn terminal section 21 and a receiving jig outer periphery surface 22a when the ultrasonic wave vibration ceases is S as shown in Figure No. 10, it must become S [less than or equal to] P/2 in order to produce cutting. Further, horn terminal section 21 must make contact by being pressed onto receiving jig outer periphery surface 22a in order to cut.

Figure No. 11 shows an individual prior art example; a groove section 32c that has a perpendicular surface 32b on the outer periphery surface 32a of receiving jig 32 is established toward the circumference, and cutting is performed by pressing the terminal section 31 of the horn that has a round shape at an angle of the groove section along with welding being performed in its area (for example, refer to the publication of Japanese Kokai Patent No. S63145013).

[Problems to be Solved by the Invention]

However, all of the cases require the terminal section of the horn to make contact by pressing onto the receiving jig outer periphery surface, and, inevitably, one or both sides of the receiving tool easily abrade the horn terminal section. Thus, there are problems like the high frequency of adjusting the aperture of the horn terminal section and receiving jig periphery outer surface and changing of the horn terminal section receiving jig and such, incurring decreased productivity and increased cost, further, the welding strength is unstable, and the cutting accuracy is inferior.

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[Means for Solving the Problems]

The present invention is a method for continuous welding and cutting of a sheet wherein a method for continuous welding and cutting of a sheet is performed by having a cylindrical receiving jig that has a rotating shaft and by a horn that is established opposing and adjacent to the said receiving jig outer periphery surface welding a plastic laminated unit in a continuous line or belt by ultrasonic vibrations of the aforementioned horn and cutting parallel to that welded section being performed, a receiving jig perpendicular surface is established on the terminal surface of a receiving jig that is

perpendicular to the rotating shaft of a receiving jig for the aforementioned receiving jig for solving the aforementioned problems, with the establishment of a route perpendicular receiving jig perpendicular surface arranged along the outer periphery surface of a receiving jig for a rotating shaft of a receiving jig at least for the aforementioned receiving jig, also, the establishment of a perpendicular surface opposing section that has a parallel surface that is connected as opposing to the aforementioned outer periphery surface opposing section, which has a surface that is adjacent as opposing to the aforementioned receiving jig outer periphery surface, and the receiving jig perpendicular surface at the terminal section of a horn, and the aperture of the aforementioned receiving jig outer periphery surface when ultrasonic wave vibration ceases and the aforementioned outer periphery surface opposing section is larger than ½ of the amplitude during the ultrasonic wave vibration (therefore, the outer periphery surface opposing section is not in contact with the receiving jig outer periphery surface) , due to the establishment such as the aperture when the aforementioned receiving jig outer periphery surface and the aforementioned outer periphery surface opposing section are closest being smaller than the thickness of 1 plastic sheet that is welded.

[Utilization]

In the aforementioned method, welding of a sheet by ultrasonic wave vibrations is produced by increasing heat generating effects by vibrations to the sheet from the outer periphery surface opposing section and the receiving jig outer periphery surface within a horn terminal section, also, cutting of a sheet is produced by melting by increasing heat generating effects by vibrations to the sheet from the perpendicular surface opposing section and the receiving jig perpendicular surface within a horn terminal section (fusing).

The outer periphery surface opposing section and the receiving jig outer periphery surface are not directly welded in the welding of a sheet, thus the abrasion of those is remarkably less as compared to cases of direct contact. Further, the closest contact aperture of the outer periphery surface opposing section and the receiving jig outer periphery surface within the ultrasonic wave vibration frequency is smaller than the thickness of a sheet 1 that is welded, and no contact with the 2 laminated sheets is required. In particular, pressing is not required for the perpendicular surface opposing section and the receiving jig perpendicular surface, therefore there is little abrasion of those.

[Example]

An example of the present invention is explained by referencing Figure No. 1 through Figure No. 6.

Figure No. 1 is a structural diagram of an entire unit that represents an example. After 2 sheets 15a, 15b are laminated by a 1st guide roller 13, [the laminated sheet] is conducted to the aperture of horn terminal section 11 that is established adjacently as opposing the cylindrical receiving jig 12 that has a rotating shaft and its outer periphery surface, that is, the receiving jig outer periphery surface 12a, welding and cutting are continuously performed there, and the cutting scraps 17 are removed, and the laminated sheet 16 with the terminal section welded is recovered through the 2nd guide roller 14. A model enlarged front view diagram of the area of a horn terminal section 11 and a receiving jig outer periphery surface 12a that are used here is shown in Figure No. 2. Further, Figure No. 3 and Figure No. 4 are side view diagrams of that; Figure No. 3 shows a model of a sheet welding and cutting position (18 represents a welded section);

Figure No. 4 shows s horn terminal section 11 in a position when ultrasonic vibration ceases by a solid line, and the positions of horn terminal section 11 when closest and when farthest during the vibration frequency when ultrasonic wave vibrations (amplitude P) are applied are both shown by broken lines. As shown in Figure No. 1 through Figure No. 3, the receiving jig 12 has a receiving jig perpendicular surface 12b that is perpendicular to the rotating shaft of the receiving jig on the terminal surface of receiving jig, further, horn terminal section 11 has a perpendicular surface opposing section 11b that has a parallel surface that contacts as opposing outer periphery surface opposing section 11a and receiving jig perpendicular surface 12b that has a surface that is established adjacently as opposing the receiving jig outer periphery surface 12a. In Figure No. 2, 2 sheets 15a, 15b that are laminated as conducted to an aperture of horn terminal section 11 and receiving jig 22 are represented by a model. Here, t represents the thickness of 1 sheet.

As shown in Figure No. 4, when the aperture of receiving jig outer periphery surface 12a and outer periphery surface opposing section 11a is represented by S when the ultrasonic wave vibration ceases and by S' (= S – ½P) when closes when the ultrasonic wave vibration (amplitude P) is applied, by determination such as becoming $S > P/2$ and $S' = S - ½P < t$, further, $P/2 < S < t + P/2$, the abrasion of the horn terminal section and receiving jig is remarkably small, moreover, continuous performance with stable welding strength and accurate cutting is possible.

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Also, in the present example, the terminal surface of the cylindrical receiving jig is used as a receiving jig perpendicular surface but, as shown in Figure No. 5 and Figure

No. 6, a step difference section or groove section perpendicular surface that is established on the outer periphery surface of a cylindrical receiving jig can be used as a receiving jig perpendicular surface.

[Effect of the Invention]

As explained above, according to the present invention, performance with stable welding strength and accurate cutting is possible since there is the possibility of little abrasion of the horn and receiving jig in a production process of continuous welding and cutting of a sheet that uses ultrasonic vibrations.

4. Simple Explanation of the Figures

Figure No. 1 through Figure No. 6 are explanatory figures of an example of the present invention; Figure No. 1 is a slanted view diagram that shows the entire structure of an example; Figure No. 2 is a model front view diagram of an essential section (horn and receiving jig outer periphery surface area) of an example; Figure No. 3 is a model enlarged side view diagram of an essential section that shows the sheet welding and cutting position for an example; Figure No. 4 is a model enlarged side view diagram of an essential section that shows the aperture of the horn and receiving jig outer periphery surface; Figure No. 5 is a an example that uses a receiving jig perpendicular surface of a step difference section; Figure No. 6 is an example that uses a receiving jig perpendicular surface of a groove section.

Figure No. 7 through Figure No. 11 are explanatory diagrams of prior art examples; Figure No. 7 is a slanted view diagram that shows an entire structure of a prior art example; Figure No. 8 is a model enlarged front view diagram of an essential section (horn and receiving jig outer periphery surface area) of a prior art example; Figure No. 9

is a model enlarged side view diagram of an essential section that shows the welding and cutting position of a sheet in a prior example; Figure No. 10 is a model enlarged side view diagram that shows an aperture of a horn and a receiving jig outer periphery surface; Figure No. 11 is a model enlarged side view diagram that shows a structure of another prior art example.

Further, symbols that are used in the figures:

11...horn terminal section

11a...outer periphery surface opposing section

11b...perpendicular surface opposing section

12...receiving jig

12a...receiving jig outer periphery surface

12b...receiving jig perpendicular surface

13...1st guide roller

15a, b...sheet

Figure No. 1 Slanted View Diagram that Shows an Entire Structure of an Example

11	horn terminal section
12	receiving jig
15a	sheet
15b	sheet

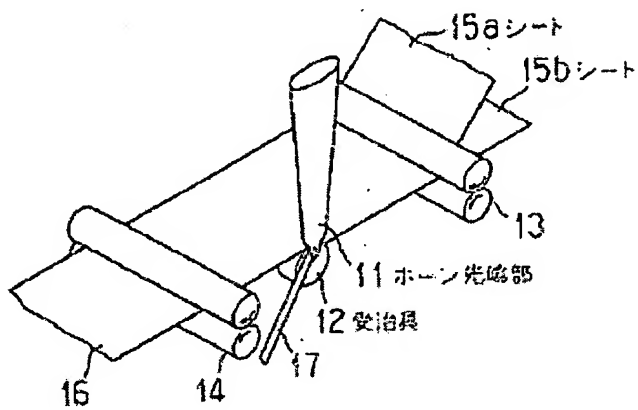

Figure No. 2 Model Front View Diagram of an Essential Section (Horn and Receiving Jig Outer Periphery Surface Area) of an Example

11a outer periphery surface opposing section
11b perpendicular surface opposing section
12a receiving jig outer periphery surface

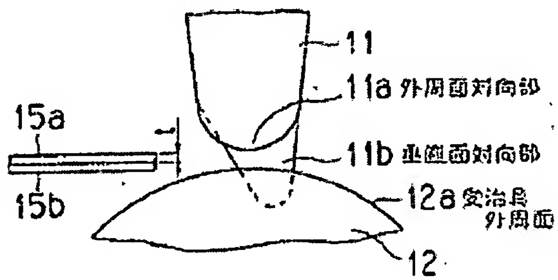

Figure No. 3 Model Enlarged Side View Diagram of an Essential Section that Shows the Welding and Cutting Position of a Sheet in an Example

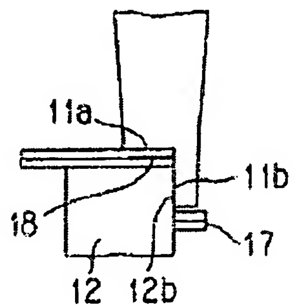

Figure No. 4 A Model Enlarged Side View Diagram of an Essential Section That Shows the Aperture of the Horn and Receiving Jig Outer Periphery Surface

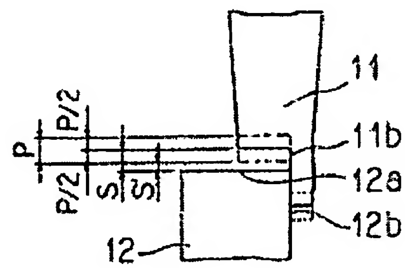

Figure No. 5 Example that Uses a Receiving Jig Perpendicular Surface of a Step Difference Section

step difference section

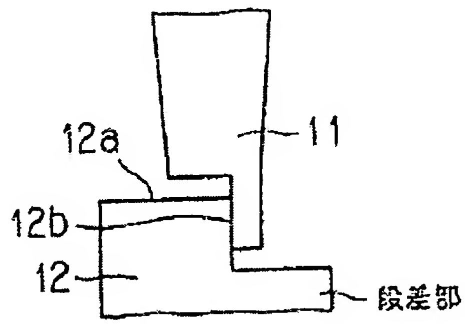

Figure No. 6 Example that Uses a Receiving Jig Perpendicular Surface of a Groove Section

groove section

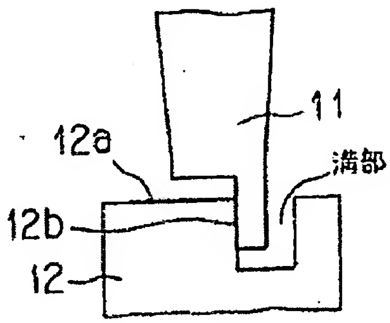

Figure No. 7 Slanted View Diagram that Shows an Entire Structure of a Prior Art Example

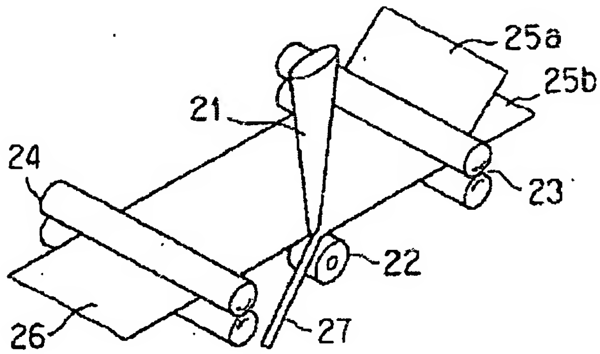

Figure No. 8 Model Enlarged Front View Diagram of an Essential Section (Horn and Receiving Jig Outer Periphery Surface Area) of a Prior Art Example

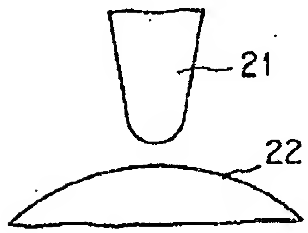

Figure No.9 Model Enlarge Side View Diagram that Shows the Sheet Welding and Cutting Position for a Prior Art Example.

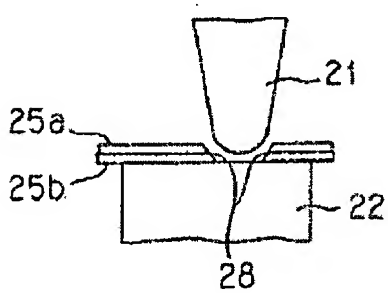

Figure No. 10 Model Enlarged Side View Diagram of an Essential Section that Shows The Aperture of the Horn and Receiving Jig

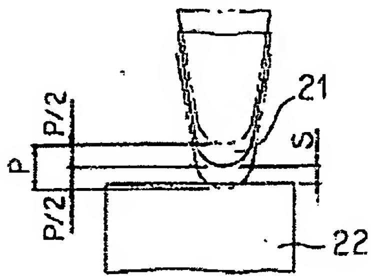

Figure No. 11 Model Enlarged Side View Diagram of an Essential Section that Shows The Structure of Another Prior Art Example